

§15. Decay Processes of Product Ions with Multiply-Excited States in Highly Charged Ion-Atom Collisions

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The mechanism of single- and multiple-electron capture processes in slow collisions between highly charged ions and atoms is currently of great importance in the understandings of basic atomic collision physics. In multiple-electron capture collisions, electrons are transferred into multiply excited levels of the highly charged ions. The product ions are stabilized by the ejections of photon(s) or electron(s). We have experimentally determined the branching ratios for each decay channel by observing the charge state distributions of product ions in coincidence with target ions for 22.5keV  $I^{15+}$  - Ne, Ar, Kr and Xe collisions.

The details of experimental procedure have been reported previously<sup>(1)</sup>. Briefly, highly charged ions produced by the electron beam ion source, NICE, were extracted at 1.5 kV. Mass-separated ions were introduced to collision region with a gas nozzle. Product ions are charge-state-analyzed with a 127° electrostatic analyzer and detected with a position sensitive detector. The charge states of recoil ions were

analyzed by the time-of-flight (TOF) method.

Fig.1 (a) - (d) shows the measured branching ratios after 2- to 5-electron capture, respectively. For the branching ratios of doubly-excited states of product ions after 2-electron capture ( fig. 1 (a) ), Auger decay is predominant. For the branching ratios of triply-excited states after 3-electron capture ( fig. 1 (b) ), double Auger decay is predominant, while the branching ratio for radiative decay is very small. The results for the branching ratios after 4- and 5-electron capture ( fig. 1 (c) and (d) ) indicate that the number of ejected electrons increase with target atomic number. This is consistent with some theoretical calculations<sup>(2)(3)</sup>. After 5-electron capture in  $I^{15+}$  - Xe collisions, quadruple Auger process has the branching ratio of about 10%. The result presents an evidence that very highly quintuple excited states are produced by five electron capture in  $I^{15+}$  - Xe collisions.

Reference

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(3) H.W. van der Hart and J. E. Hansen, J. Phys. B26 (1993) 641

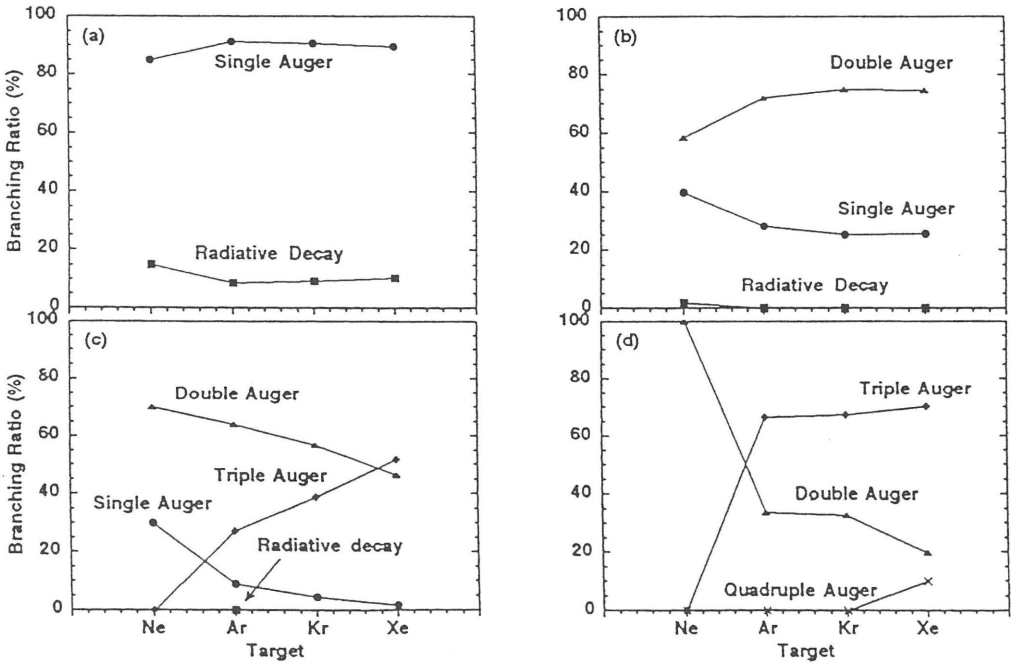


Fig.1 Branching Ratios for the Decay of Product  $I^{(15-j)+}$  Ions after  $j$ -electron capture in  $I^{15+}$ -Ne, Ar, Kr, Xe  
(a)  $j=2$  (b)  $j=3$  (c)  $j=4$  (d)  $j=5$